WHAT IS CLAIMED IS:

1. A radiographic imaging method for three-dimensional reconstruction, for calculating a three-dimensional model of at least one object to be imaged in a field of observation, said object having at least one characteristic portion, the method including a step during which:

c) the three-dimensional shape of a model representing the object is calculated on the basis of a geometrical model of the object that is known a priori;

wherein a step b) is implemented of calculating at least one estimator corresponding to at least one geometrical characteristic of the object on the basis of a confinement volume of said characteristic portion of the object, said confinement volume being estimated from at least one geometrical pattern visible in two two-dimensional radiographic images of the field of observation taken from a source having a position in two non-parallel image-taking directions, and from said position while taking the image;

said geometrical model comprising information associated with the three-dimensional shapes of objects of the same kind, enabling the geometrical characteristic for the model representing the object to be established from the estimator.

2. A method according to claim 1, in which step c) comprises steps of:

c1) estimating a local frame of reference associated with the object on the basis at least of information taken from the geometrical patterns visible in each image;

c2) determining three-dimensional positions of control marks for the object in the local frame of reference by inference on the geometrical model using the estimator; and

c3) calculating the three-dimensional shape of the model representing the object by deforming a predetermined generic model corresponding to said object, said generic model having marks that correspond to said control marks, whereby said model representing the object approximates a shape that is close to being an isometric transformation of the generic model, while nevertheless maintaining coincidence between the marks of the deformed generic model and said control marks.

3. A method according to claim 1, in which said geometrical model is constituted by a database containing geometrical information associated with at least one of the following properties:

- the coordinates of control marks for a set of said objects of the same kind; and
- characteristic dimensions of a set of said objects of the same kind.

4. A method according to claim 3, in which step c) is performed by statistical inference on said database by using said estimator as a predictor.

5. A method according to claim 1, in which, during step b), said confinement volume is determined from a ruled surface defined by at least said geometrical pattern derived from projecting said characteristic portion of the object onto the first image and the trajectory of a first radioactive source while taking the first image, and a ruled surface defined by at least said geometrical pattern derived from projecting said characteristic portion of the object onto the second image and the trajectory of a second radioactive source while taking the second image.

6. A method according to claim 5, in which said geometrical patterns are identified manually by a user on each image.

7. A method according to claim 5, in which said geometrical patterns are determined by digitally processing each of the images, said geometrical patterns being obtained by analyzing the brightness of the images.

8. A method according to claim 1, in which the light intensity obtained for each pixel of each image is divided by a brightness value of a compressed fuzzy image of the same object.

9. A method according to claim 8, in which said compressed fuzzy image is obtained by recalibrating for each image mean brightness values for each pixel obtained by taking for each pixel a weighted mean of the brightness values of neighboring pixels.

10. A method according to claim 1, in which interference due to at least one interfering anatomical structure is reduced in at least one image by subtracting from said image an attenuating image representative of the influence of said interfering anatomical structure obtained on the basis of a characteristic which is known a priori about said anatomical structure.

11. A method according to claim 1, further comprising a step a) during which said two images are obtained by simultaneous scanning of the field of observation in a scanning direction, by detecting signals from two non-parallel X-ray beams passing through the field of observation and forming an irradiation plan, said scanning direction being non-coplanar with said irradiation plan.

12. A method according to claim 11, in which said scanning is appropriately synchronized with detection so that successive signals coming from the same zone of the field of observation are summed during detection.

13. A radiographic imaging method for three-dimensional reconstruction, for calculating a three-dimensional model of a first object to be imaged in a field of observation that further comprises at least one second object presenting a three-dimensional relationship with the first object, each of the first and second objects having at least one characteristic portion, the method comprising a step during which:

c) the three-dimensional shape of a model representing the first object is calculated from a geometrical model of the object that is known a priori;

wherein a step b) is implemented during which at least one estimator corresponding at least to said relationship is calculated on the basis of a confinement volume, said confinement volume being estimated from at least one geometrical pattern representative of each object visible in two two-dimensional X-ray images of the field of observation taken from a source having a position in two non-parallel image-taking directions, and from said position while taking the images;

said geometrical model comprising information associated with the three-dimensional shapes of objects of the same kind, enabling the geometrical characteristic for the model representing the first object to be established from the estimator.

14. Radiographic imaging apparatus for three-dimensional reconstruction, for calculating a three-dimensional model of at least one object to be imaged in a field of observation, said object including at least one characteristic portion, the apparatus comprising:

c) means for calculating the three-dimensional shape of a model representing the object from a geometrical model of the object that is known a priori; and

b) means for calculating at least one estimator corresponding to at least one geometrical characteristic of the object from a confinement volume of said characteristic portion of the object, said confinement volume being estimated from at least one geometrical pattern visible in two two-dimensional radiographic images of the field of observation taken from a source having a position, in two non-parallel image-taking directions, and from said position while taking the images;

said geometrical model comprising information associated with the three-dimensional shapes of objects of the same kind enabling the geometrical characteristic for the model representing the object to be established from the estimator.

15. A computer program including portions of program code for executing the steps of the method according to claim 1.

16. A method of determining a geometrical pattern for a vertebral body to be imaged in a field of observation containing said vertebral body and a neighboring inter-vertebral space, said geometrical pattern being visible in a two-dimensional radio-graphic image of the field of observation taken from a source in a taking direction, in which the following steps are performed on the image:

γ) estimating side walls derived from projecting each vertebral body onto said image;

δ) estimating at least one zone of least gray level in the image derived from projecting a zone of the field of observation containing said intervertebral space, said zone being substantially orthogonal to the side walls by

analyzing the brightness characteristics of the image; and

ε) determining at least one corner of the geometrical pattern as the point of intersection of said intervertebral space with said side wall.

17. A method according to claim 16, in which the following steps are performed prior to step γ:

α) calculating an estimated characteristic line of the vertebral body; and

β) straightening the image by applying a first deformation so that said characteristic line, once straightened, is substantially a straight line segment;

applying steps γ), δ) and ε) to said straightened images to obtain at least one straightened geometrical pattern, and after step ε):

ζ) obtaining the geometrical patterns by applying a second deformation to said straightened geometrical patterns obtained in step ε), the second deformation being such that the pattern obtained by applying it to said straightened image is positioned close to the pattern on the original image.

18. A method according to claim 17, in which, during step δ):

δ1) a mean brightness value is estimated for each line of pixels in the image orthogonal to said characteristic line in the image plane; and

δ2) a projection of said intervertebral space is estimated by applying a brightness threshold to said mean values.

19. A method according to claim 16, in which, during step γ), projections of the side walls of the vertebral body are estimated by deforming an initial side wall estimated from the geometrical model.

20. A method according to claim 16, in which, during step γ), said projections of the side walls are estimated by minimizing a cost function indexed on the contrast of the image and a mean side wall of said vertebral body estimated from a database of vertebral bodies.

21. A method according to claim 17, in which step α) is modified in that it includes calculating an estimated characteristic line of a portion of the vertebral spine, and in which, during step α), said characteristic line is calculated by interpolating a suitable number of points of said vertebral spine projected on said image as supplied by a user.

22. A method according to claim 7 wherein the object to be imaged is a vertebral body and wherein said geometrical pattern is determined by using the method of step 16 on each image.

23. A computer program including portions of program code for executing the steps of the method according to claim 16.